R. F. MacMICHAEL.

VISCOSIMETER.

APPLICATION FILED OCT. 5, 1914.

1,281,042.

Patented Oct. 8, 1918.

2 SHEETS—SHEET 1.

Fig. 1

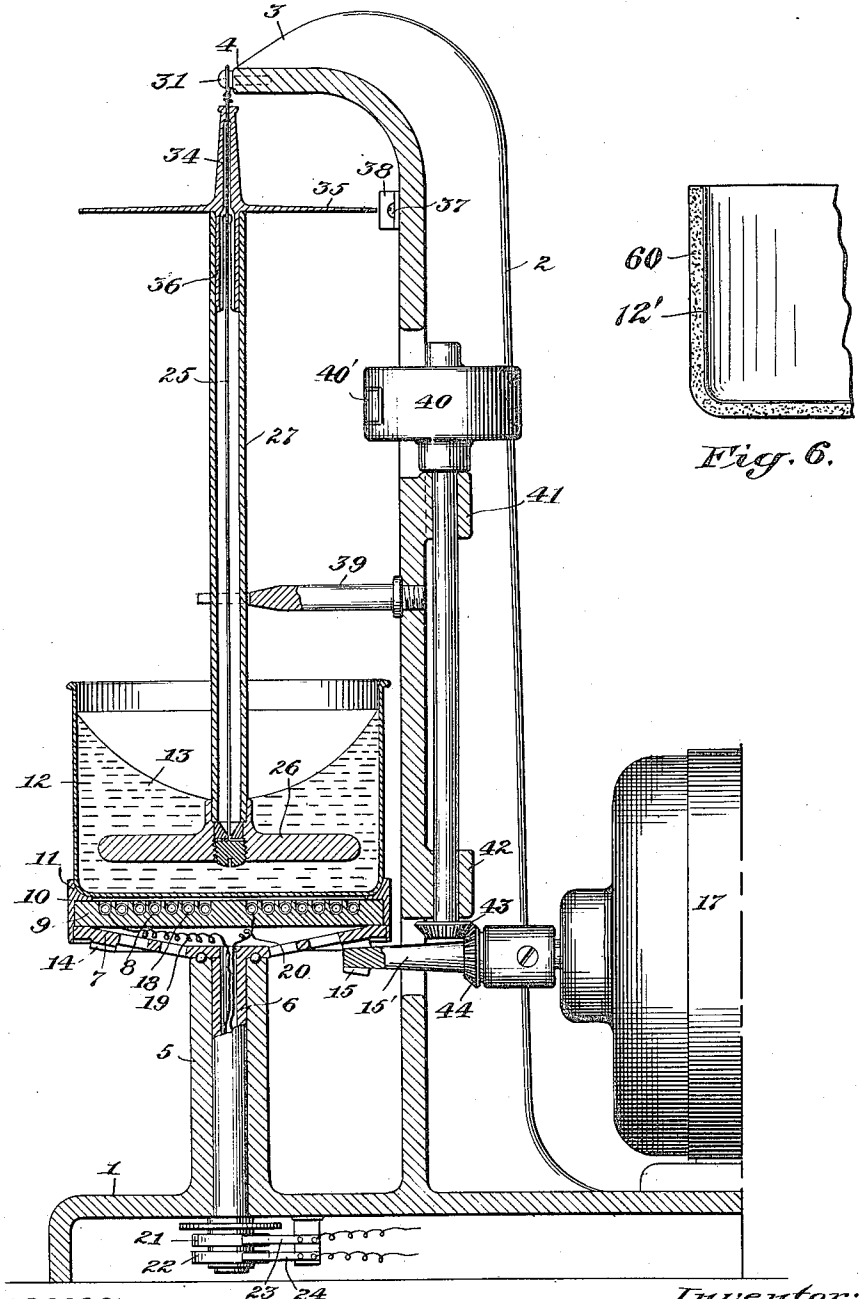


Fig. 6.

Witnesses:

E. C. Tate.

C. H. Potter.

Inventor:

Ross F. MacMichael

by Byrnes Townsend & Brickenstein,

Att'ys.

R. F. MacMICHAEL.

VISCOSIMETER.

APPLICATION FILED OCT. 5, 1914.

1,281,042.

Patented Oct. 8, 1918.

2 SHEETS—SHEET 2.

Fig. 2.

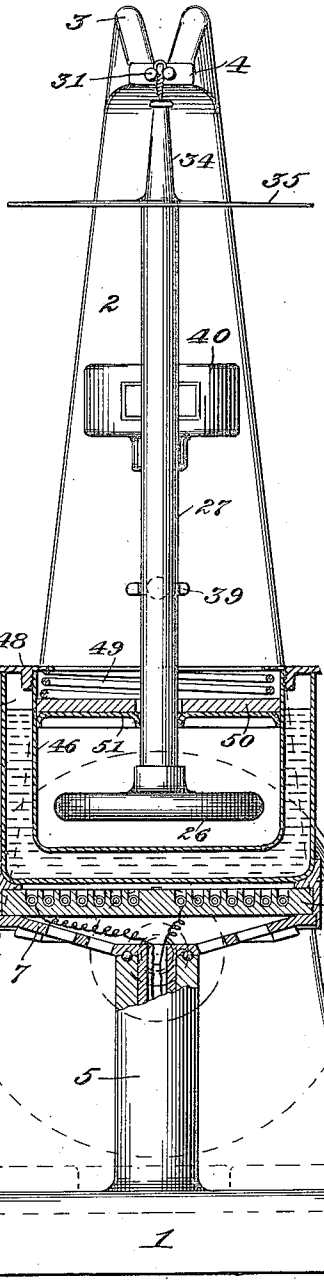


Fig. 3.

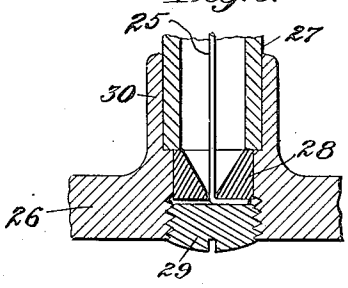


Fig. 4.

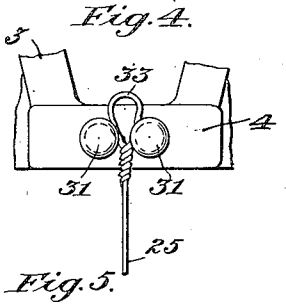
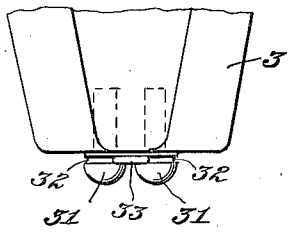


Fig. 5.



Witnesses:

E. C. Tate.

C. H. Potter.

Inventor:

Ross F. MacMichael

By Bowes Townsend & Buckwalter,

Att'ys.

UNITED STATES PATENT OFFICE.

ROSS F. MacMICHAEL, OF AUBURN, WASHINGTON.

VISCOSIMETER.

1,281,042. Specification of Letters Patent. Patented Oct. 8, 1918.

Application filed October 5, 1914. Serial No. 865,171.

To all whom it may concern:

Be it known that I, Ross F. MacMichael, a citizen of the United States, residing at Auburn, in the county of King and State of Washington, have invented certain new and useful Improvements in Viscosimeters, of which the following is a specification.

This invention relates to viscosimeters, and has for its object the provision of an instrument indicating by a direct reading the viscosity of liquids, suspensions, and other substances, such as oils, greases, clay-slips, etc.

The viscosimeter, in its preferred form, comprises a receptacle for the liquid or substance to be tested, means for rotating the receptacle about a vertical axis and for determining its rate of rotation, and a disk or plunger, supported in the liquid by means of a torsion element. Under these conditions the angular displacement of the plunger indicates the viscosity of the liquid to be tested, and may be read directly from a suitable scale, the instrument having been first calibrated for a standard liquid, as for example water at a given temperature.

The invention will be fully understood by reference to the accompanying drawings, in which,—

Figure 1 is a central vertical section of a preferred form of the device, some of the parts being shown in elevation;

Fig. 2 is a front view, certain of the parts being shown in section, and a modified form of receptacle being illustrated;

Fig. 3 is a detail view of a preferred form of clamp for securing the plunger to the torsion element;

Figs. 4 and 5 illustrate in front elevation and plan view, respectively, a preferred form of suspension-means for the torsion element; and

Fig. 6 is a fragmentary vertical section of a receptacle provided with a jacket of heat insulating material.

In the particular form illustrated, the device comprises a hollow metal base 1 and an integral standard 2, the standard having a head 3 terminating in a substantially flat nose 4. Extending vertically upward from the base 1 is an integral tube 5 adapted to receive a depending tubular projection 6 of and to provide a bearing for a cup-supporting plate 7, the latter being apertured, preferably, as at 8, for ventilation. The outer edge of the upper surface of the plate 7 is flattened, and forms a seat for a heating-coil tray 9, and an annular ring 10 surrounds the members 7 and 9. The ring 10 is provided with an inwardly-projecting portion 11 rounded, on its inner face, to provide a seat for and snugly fit the lower edge of a cup 12 adapted to receive the substance 13, the viscosity of which is to be measured. The supporting-plate 7 is provided on its underside with a circular rack 14 adapted to mesh with a pinion 15 of a coupling-shaft 15′ removably secured by a set-screw 16 upon the extended shaft of an electric motor 17, the latter being suitably mounted upon the base 1. The heating-coils 8 are electrically connected by wires 19 and 20 to the rings 21, 22, the latter being connected to a suitable source of current through the brushes 23, 24.

Suspended from the nose 4 by means of a torsion element 25, a steel wire or ribbon being suitable for the purpose, is a disk or plunger 26, supported centrally within the cup 12 somewhat beneath its central line. The wire 25 is inclosed for the greater part of its length in a tube 27, and is secured to the plunger 26, as follows: The lower end of the wire 25 (see Fig. 3) is bent at right-angles upon the lower face of a steel bushing 28 and is clamped thereagainst by a hardened-steel screw-plug 29, which also binds the bushing against the lower edge of the tube 27. The friction-disk or plunger 26 is provided with a collar 30, and the outer surface of the lower portion of the tube 27 is turned true and soldered thereinto.

A preferred form of suspending-means for for the torsion wire is illustrated in Figs. 4 and 5, and comprises two hardened steel pins or pegs 31 carried by the head of the standard 2, each pin being provided with an annular groove 32, the grooves of the two being in alinement. Between the two pins 31 is dropped the wire 25, the upper end of the latter being bent to form a loop 33, and the sides of the loop are adapted to rest in the adjacent faces of the grooves 32. By this arrangement, it will be seen that the wire 25 is restrained from any twisting movement at or above its point of suspension, but the plunger and its support may be instantly removed.

Practically all of the portion of the torsion wire 25 not covered by the tube 27 is housed within an elongated collar 34 formed integral with a graduated brass dial 35, and the

latter is frictionally secured within the upper end of the tube 27 by means of an integral split collar 36. The dial may be graduated in angular degrees, in absolute or arbitrary units, or otherwise as desired. The internal diameter of the collar 34 is reduced at its upper end to receive the wire 25 snugly. Secured to the standard 2 by means of screws 37 opposite the dial 35 is a pointer 38, and the adjustment of the dial 35 to its zero position, when the parts are at rest, may be effected by rotating the dial and the split collar 36 within the tube 27. In order to prevent undue vibration of the friction-disk or plunger 26, a forked arm 39, adapted to receive the tube 27 at its outer end, may be threaded or otherwise secured to the standard 2.

Since it is necessary, as in calibrating the instrument, to ascertain the speed of the motor 17, unless the latter is of the constant-speed type, a tachometer 40 is mounted in bearing-lugs 41, 42, on the standard 2, and its shaft is connected at one end through the bevel-gears 43, 44 with the removable coupling-shaft 15'. The tachometer may thus be arranged so that its scale 40' is in proximity to the dial 35, for convenience in making readings.

In calibrating the machine, as when inserting a new wire, the speed of the motor is so adjusted that with water in the cup 12, heated to a definite temperature, say 100° F., there is a deflection of say 100 indicated by the dial 35. Under these conditions, the "dead" pointer of the tachometer is set as at the zero position. Other temperatures and degrees of angular deflection may of course be used in standardizing the instrument.

In determining the viscosity of a liquid, a quantity thereof is placed in the removable cup 12, the latter is fitted into the ring 11, the plunger 26 is immersed and suspended by the wire 25 upon the pegs 31, and current is supplied to the motor 17. The cup 12 and the liquid 13 are thereby rapidly revolved, the speed of the motor being maintained at the point required to show with water at 100° F. a deflection of 100° on the dial 35, as above determined. The friction-disk or plunger 26 will receive an angular deflection depending upon the viscosity of the substance 13, and this viscosity can be read directly from the graduated dial 35. If it is desired to ascertain the viscosity of the substance at temperatures higher than normal, current is supplied to the heating-coils 18, and a thermometer can be immersed in the liquid. The agitation of the liquid insures uniform heating thereof. For low temperatures, the cup, fluid and plunger may be chilled in brine, thus dispensing with the familiar "cold test" of oil users.

Subsequent calibrations or adjustments may be effected in any one of several ways. For instance, by raising or lowering the plunger 26 in the material 13, or by inserting loose washers of varying thicknesses under the cup 12 to raise or lower the same, the effective hydraulic radius may be changed; or, the effective length of the torsion element 25 might be varied, as by clamping it at a point intermediate its length, or by using interchangeable wires, or an interchangeable dial might be furnished with each new torsion wire. If the motor is provided with a governor serving to maintain its speed constant, of course the tachometer may be dispensed with.

In determining the viscosity of grease or similar viscous substances, the form of cup shown in Fig. 2 is preferred. In this form, the cup has spaced outer and inner walls 45 and 46, respectively, providing a water-jacket 47 therebetween. The inner wall 46 receives a threaded cap 48, serving to retain within the grease-cup a coil spring 49, and, extending across the top of the outer wall 45, affords a cover for the water-jacket 47. The spring 49 presses upon a follower 50 of a grease-retaining ring 51, the latter fitting about the tube 27, and preferably having its central and peripheral edges bent downwardly to more effectively retain the grease within the cup. By such a construction, there is eliminated the tendency of the grease to pile up during rotation around the plunger 26, and the pressure on the grease being substantially constant, there is no danger of its affecting the accuracy of the readings. The water in the jacket 47 causes an even temperature throughout the mass being treated.

Other methods of heating the substance may of course be substituted for the coils, and an alcohol or other flame may be applied directly beneath the cup through the apertures 8 of plate 7. A water-jacket or an oil-jacket similar to that shown in Fig. 2 might also be provided for the cup shown in Fig. 1, or the cup may be surrounded with heat-insulating material 60, if desired, as shown in Fig. 6.

From the foregoing, it will be seen that with the use of an apparatus constructed according to this invention, the readings may be made with great accuracy, as the dial and plunger are frictionless and practically free from vibrations. Values within one-half per cent. are readily obtained, and when a check-reading is desired, the direction of rotation may be reversed and readings taken from the dial 35 along the other side of the zero mark. Small particles of sediment or foreign matter do not in any way affect the accuracy of the determination. Readings may be made as soon as the machine has attained full speed. No timing or counting of any sort is necessary, and no stop-watch is required. The deflection may be maintained

as long as desired, and readings taken in a careful and leisurely manner. The parts in contact with the fluid are of the simplest form, with smooth rounded surfaces, which may be cleaned rapidly and thoroughly. Both the cup and plunger are self-centering, and may be removed and replaced without manipulating catches or fastenings.

Two torsion wires will easily cover the entire range of liquids likely to be met with in ordinary practice, from the lightest alcohols to heavy cylinder oils and glycerin. By means of the heating-coils, the value for a fluid for any temperature above normal may be readily obtained in a continuous operation without removing the fluid from the cup. As the machine runs constantly during the test, the liquid is thoroughly stirred while heating and is of uniform temperature throughout. The machine is not delicate, and does not require an expert operator. In case the torsion wire should become damaged it can be quickly replaced with the use of an ordinary screw-driver. The machine may be calibrated and its accuracy checked against water at any time, requiring only a few minutes' manipulation.

In certain of the claims, the word "stationary" has been employed to describe the condition of the plunger after the parts have attained equilibrium, during the operation of the machine.

I claim:—

1. In a viscosimeter, a plunger arranged for immersion in the substance to be tested, a torsion element adapted to suspend said plunger, means for imparting a movement of rotation to the body of the substance, a dial for indicating the deflection of the plunger, a tube inclosing the torsion element and connecting said plunger and dial, and means for adjustably securing said dial to said tube.

2. In a viscosimeter, a plunger arranged for immersion in the substance to be tested, a torsion element adapted to suspend said plunger, a bushing in said plunger, the lower end of said torsion element being bent over the underside of said bushing, and a screw-plug in the lower face of said plunger for binding said torsion element against the bushing, and means for imparting a movement of rotation to the body of the substance.

3. In a viscosimeter, a base, a standard thereon, a plunger arranged for immersion in the substance to be tested, a torsion wire adapted to suspend said plunger, a pair of annularly grooved pins in the upper extremity of said standard, said torsion wire having a loop at its upper end adapted to rest in the adjacent faces of the grooves of said pins and to be thus supported by the standard, and means for imparting a movement of rotation to the body of the substance.

4. A viscosimeter comprising a vessel adapted to contain the substance whose viscosity is to be determined, said vessel comprising a cup having a substance-retaining disk, a spring-pressed follower for said disk, and a cap-plate, a plunger arranged for immersion in the substance, a torsion-element adapted to suspend said plunger, means for rotating said vessel, and means for indicating the deflection of the plunger.

5. A viscosimeter comprising a base, a bearing thereon, a container-support on said bearing, a container removably seated on said support and adapted to contain the substance to be tested, a relatively flat, horizontal disk arranged for immersion in the substance, a torsion element removably secured at its upper end and adapted to suspend said disk, means for rotating said container-support, and means for indicating the angular deflection of the disk.

6. A viscosimeter comprising a base, a bearing thereon, a container-support on said bearing, a container, removably seated on said support and adapted to contain the substance to be tested, a body arranged for immersion in the substance, a torsion element removably secured at its upper end and adapted to suspend said body, means for rotating said container-support, means for indicating the angular deflection of the body, and an electrical heating-coil for controlling the temperature of said substance.

7. A viscosimeter comprising a base, a bearing thereon, a cup-support on said bearing, a cup removably seated on said support and adapted to contain the substance to be tested, a relatively flat, horizontal disk arranged for immersion in the substance, a torsion element removably secured at its upper end and adapted to suspend said disk, means for rotating said cup-support, means for indicating the angular deflection of the disk, and a pancake electrical heating-coil in said cup-support for controlling the temperature of said substance.

In testimony whereof I affix my signature in presence of two witnesses.

ROSS F. MacMICHAEL.

Witnesses:

K. R. Ehle,

C. F. Ruddiman.